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BURNS*

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IT is now recognized that the treatment of a severe burn should be aimed at the prevention of its two major complications, shock and infection. It is a great deal easier to prevent or treat these complications early than to relieve them after they have developed. Many types of local therapy have merit, and two of these will be discussed later. All are agreed, however, on the therapy necessary for the prevention and treatment of shock in a severe burn. The mortality which previously occurred early in severe burns has been greatly reduced by the use of adequate transfusions of plasma. It must be remembered that, though it is not always possible to carry out ideal therapy, care can and should be taken not to institute therapy which might be harmful. Few surgical conditions necessitate the wide knowledge and meticulous care that a severe burn does.

EMERGENCY CARE AND FIRST-AID TREATMENT

All patients with severe burns must receive immediate treatment for shock. They should be placed in a supine position and given an injection of morphine. At least one-half grain is necessary to alleviate the severe pain, and to help combat the shock which accompanies an extensive burn. If it is anticipated that the patient will be immediately transported to a hospital, no local therapy should be carried out except to prevent the burn from being contaminated during the period of transportation. If possible, sterile gauze should be applied to the burned area and, if this is not available, clean linen should be used and the patient covered with a blanket or some article of clothing to keep him warm.

If it appears that it will be impossible to hospitalize the patient in less than two hours, local treatment may be carried out as follows, if the materials are available. No effort is made to remove more clothing than is necessary to expose the burned surfaces. Rings should be promptly removed from the fingers of burned hands. Burned surfaces may be covered with a sterile boric ointment, petrolatum or 5 per cent sulfathiazol water-soluble jelly spread on a layer or two of fine mesh gauze (44). Large gauze dressings or sterile cotton waste is placed over these dressings and the entire dressing bandaged firmly in place. If the burn is on an extremity, a splint will simplify its handling and offer a more comfortable means of transportation. Ointments or jellies containing tannic acid are no longer recommended for the first aid treatment of burns, and should not be used. A certain proportion of burns become infected by organisms present in the skin about the burn. A still larger proportion become infected by organisms later introduced into the burned area. For this reason every effort should be made to minimize secondary contamination. With these facts in mind it is important that the patient and all attendants handling burn cases should be capped and masked if it is possible. If it is impossible to cover the burned area with sterile gauze, all efforts should be made to keep from contaminating the burned area. The injection of undiluted plasma intravenously should be instituted as soon as possible.

DEFINITIVE TREATMENT

The definitive treatment of a severe burn should be carried out as soon as the patient reaches a location where the facilities are adequate, and the patient will remain sufficiently long to receive the treatment. The first consideration, of course, is the treatment of shock. Additional morphine is usually required and the transfusion of plasma should immediately be instituted. Since every severely-burned patient will require plasma, its administration should be started immediately without waiting for laboratory reports. Those who are responsible for the treatment of extensive burns should be familiar with the Berkow method of estimating the extent of cutaneous lesions. After figuring the percentage of the body which has been burned, it is possible to estimate roughly the amount of plasma required for the patient during the first 24 hours. If the

* One of several papers in a Symposium on "Emergency Medical Service in Wartime." Papers collected by Henry Gibbons, III.

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burn involves 10 per cent or more of the body surface, 50-100 c.c. of plasma should be administered for each per cent of the body surface burned. For example, a patient who has had 10 per cent of the body burned should receive 500-1000 c.c. of undiluted plasma during the first 24 hours. For those with severe burns a large amount of plasma may be necessary during the first 24 hours; this is usually given in divided doses. After the injection of plasma has been instituted, the laboratory work which can be used as a guide for the amount of additional plasma required should be done. The hemoglobin, or even more valuable, the hematocrit reading should be carried out regularly. For each point that the hematocrit rises above 45 per cent cells, at least 100 c.c. of plasma should be administered. If clinically satisfactory results are not obtained with this dosage, larger quantities should be given.

Other Fluids:

Large quantities of saline and glucose should not be administered. The volume of both should not exceed the amount of plasma injected in a given period of 24 hours. In cases of severe hemo-concentration, larger quantities may be given slowly. If additional fluids are necessary, a 5 per cent solution of glucose in distilled water is preferable, as it has been shown that large amounts of neutral sodium salts, such as sodium chloride, will intensify the tendency to edema. The patient may be permitted to drink moderate amounts of water, but no food should be offered until his stomach can retain it and the shock has been overcome; then food and fluids may be given orally as desired.

When the patient is in a state of shock, with his extremities cold and his pulse weak and thready, caution must be exercised against warming him too rapidly by externally applied heat. Sudden warming of the skin in the presence of inadequate blood volume may precipitate complete circulatory collapse by dilation of the peripheral vessels.

Whole Blood Transfusions:

Transfusions of whole blood should not be given in the early treatment of a burned patient unless hemorrhage has occurred from other injury, and then only when the state of shock has been satisfactorily overcome by the use of plasma. If no plasma is available blood may be substituted. Anemia frequently develops after several days following a severe burn, and in this event, whole blood is necessary and should be administered as indicated.

Care of Burned Area

Regardless of the method of local therapy, some definite measures should be instituted to prevent additional contamination of the burned area. For this reason the surgeon and his assistants should be capped, masked and gloved. The dressing is removed carefully and the burnt area inspected. All clothing is cut away if necessary. Ether, benzine, lard or other detergents should be used to remove grease if present. With plain white soap, soft cotton and sterile water, the burned area should be cleansed gently and as thoroughly as possible. Loose epidermis and foreign material may be removed with sterile forceps and scissors. Remember that it is rarely necessary to wash a freshly burned surface. Scrub brushes, green soap and vigorous rubbing do more harm than good.

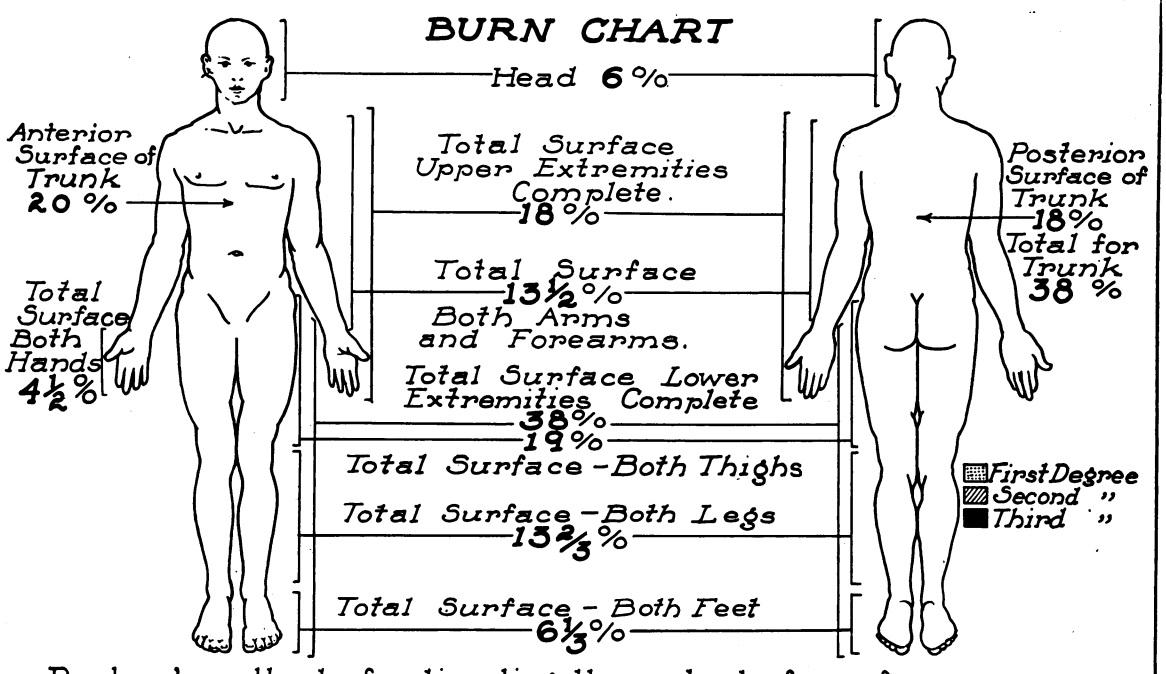
Common Types of Treatment

The Pressure Dressing Method:

Over the prepared surfaces apply gauze of fine mesh impregnated with sterile boric acid ointment, petrolatum, lanolin, 5 per cent sulfathiazol jelly or 3 per cent xeroform in petrolatum. Over this place sufficient sterile gauze or sterile cotton wadding to provide a thick layer that furnishes smooth, even compression when bandaged firmly in place. For the pressure dressing, stockinette or some type of elastic bandage is more effective than rolled gauze bandage. If an extremity is involved, start the dressing near the tips of the digits. Separate the digits, and if possible, carry the dressing well above the burned area. A splint may be added as a final step in dressing an extremity. The finger tips, if unburned, may be left exposed so that the circulation can be checked. Be very careful that sufficient pressure pads are placed over prominent bones and about the fingers. Properly applied pressure dressings may be left in place from twelve to fourteen days. At the end of that period areas of partial skin thickness loss should be healed. Areas of necrotic whole thickness loss are excised, usually followed by wet dressings. From this time on the granulating area is not treated as a burn, but as any granulating wound would be treated, and every attempt is made to clean it up as quickly as possible and to prepare it for skin grafting.

The Escharotic Method:

This method is particularly indicated in extensive flash or superficial second-degree burns of the trunk. The hands, face, feet, perineum and genitalia should never be tanned. These areas should be treated as described under the pressure method. The tanning escharotic method should never be used unless the burn can be treated immediately, and not even then if it has been grossly contaminated. When tanning is employed, one should use the method of rapid coagulation, such as the combined use of tannic acid and silver nitrate. Slow methods of tanning, such as are obtained with tannic acid jelly or tannic acid solution without silver nitrate, permit absorption of the acid with a possibility of serious toxic effects, particularly necrosis of the liver. Furthermore, many hours are required to effect an adequate tan, allowing opportunities for contamination. Two spray guns are to be available. One is to contain only the tannic acid, the second, equal parts of tannic acid and silver nitrate solution. Less pain is experienced if the tannic acid alone is applied first, followed immediately by the tannic acid-silver nitrate spray. One half hour later, and every half hour



Berkow's method of estimating the extent of surface area.

	ADULTS	CHILDREN	ESTIMATE
Head	6%	12 minus age in years plus 6	
Trunk	38%	40%	
Lower extremities	38%	38 minus (12 minus age in years)	
Upper extremities	18%	16%	
		Total	

BURN SHOCK

	Initial			12 Hrs.	1 Day	2 Days	3 Days	4 Days	5 Days	6 Days
B.P.										
Pulse Rate										
Hemoglobin (100% = 14.5 gms.)										
R.B.C.										
Hematocrit										
Plasma Proteins										
A/G. Ratio										

FLUID REPLACEMENT THERAPY (cu. cms.)

Plasma								
Whole Blood								
Saline								
Glucose								
5% Glucose in saline								
Urinary Output								
Blood Substitute								

for four applications, spray with the tannic acid-silver nitrate mixture. If the tan is not then adequate, continue spraying every hour until the objective is achieved. While drying, the burned area should be left exposed to the air under a canopy, heated if the environmental temperature is low. The bed should be kept covered with sterile linen if the eschar is to be left exposed. After the eschar is dry it may be covered with sterile dressings.

If the burn is second degree, skin will regenerate beneath the tan and the latter will separate spontaneously. If the eschar remains intact for three weeks, it may be assumed that a third-degree burn has been sustained, and the eschar should be removed. It is usually neces-

sary to carry this out under light general anesthesia.

Paraffin Wax Method:

More recently this method has been revived and modified by Doctor R. C. Pendleton at the Mare Island Naval Hospital. Many of those who have had experience with this method are enthusiastic about the ease and economy with which it can be carried out. This essayist has had no experience with the method and therefore does not feel qualified to present an opinion.

Infection Beneath Eschar:

If infection occurs beneath the tan or eschar, or the patient shows systemic or local signs of sepsis, the eschar should be carefully inspected. If an area looks suspicious a hole should be made through the eschar and, if pus is encountered, the entire area of suppuration should be unroofed by means of sterile sharp instruments. This can usually be done without much trauma and without anesthesia. The suppurating surface should then be treated by wet saline compresses, as for any infected granulating wound. Crystalline sulfanilamid may be applied over the exposed surfaces daily thereafter. If the area is large, no more than 15 grams of sulfanilamid should be used in any one 24-hour period, as toxicity may result.

Treatment of Granulating Areas:

It must be remembered that all third-degree burns result in granulating areas. These granulating areas must be effectively and rapidly cleaned up in preparation for skin grafting, if the patient is to be spared the septic stage of a burn during which anemia, cachexia and damage to kidneys and livers may occur. Recently we have learned that the process of "cleaning up" may be greatly accelerated by the daily use of a light dusting of sulfanilamid crystals and the application of compresses to the area, thus permitting the application of skin-grafts earlier than heretofore. Dressings always should be as painless as possible.

Oral Administration of Sulfonamide Drugs:

Although it has not been routinely our custom to give sulfa drugs by mouth to patients with severe burns, sulfadiazine by mouth may be administered, particularly if the definitive treatment is delayed. This drug has been chosen because it is the least toxic of the three commonly used sulfa drugs. The dosage is 1 gram every 6 hours, day and night for ten days. If sensitivity is present it may be necessary to use one of the other drugs. It is dangerous to give a sulfonamid drug to a patient who is not voiding normally over 1000 c.c. per day.

SUMMARY

1. The treatment of a severe burn should be aimed at the prevention of shock and infection.

2. The use of blood plasma in the treatment of shock has materially reduced the early mortality in severe burns. 50-100 c.c. of plasma should be administered for every per cent of the body burned.

3. Simple first aid measures may be carried out anywhere if materials are available, but definitive treatment should only be instituted where facilities are adequate.

4. Every effort should be made to minimize secondary contamination of the burn.

5. Large quantities of saline and glucose should not be administered, as they tend to intensify the edema and dilute the blood proteins.

6. Whole blood transfusions should not be used in the early-burn treatment, unless hemorrhage has occurred, or plasma is not available. Later, when anemia appears, blood transfusions are indicated.

7. Strong antiseptics or vigorous scrubbing should never be used on a burn. Plain white soap, cotton and sterile water will cleanse the area adequately.

8. The two most commonly-used methods of local therapy are the pressure dressing method and the tannic-acid and silver nitrate escharotic method.

9. All third degree burns result in granulating areas. These areas should be cleaned up as rapidly as possible in preparation for skin grafting.

10. Sulfadiazine may be administered orally to severe burns, particularly if proper therapy cannot be instituted early.

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CRUSH SYNDROME

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CRUSH syndrome was recognized clinically during the last war, but little literature was devoted to it then. It has since then, for a time, been dropped entirely from the literature of medicine. Within recent years reports have again appeared, mostly in British literature, concerning this syndrome. Most of the reported cases have been victims of bombing attacks who had been imprisoned beneath heavy débris and suffered prolonged crushing injury to a mass of muscle tissue.

The individual who has been pinned beneath fallen débris for a period of time in such a way as to have a mass of muscle tissue crushed, and its vascular supply injured, is subject to this syndrome. He may or may not show vascular shock at the time he is extricated. The presence or absence of primary shock should not in any way lead one away from being on guard against the crush syndrome. The crush syndrome may appear at any time from two to forty-eight hours following release from the compression. Crush syndrome is a toxic condition of the kidneys resulting from the absorption of broken-down muscle proteins following sudden release from pressure. It is characterized by the classical symptoms of destruction of the kidney, and its failure to perform its function of secretion. All

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